AMENDMENT

(Amendment by Provision of the Law Article 11)

To : Examiner of the Patent Office

(Seal)

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1. Identification of the International Application

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4. Object of Amendment Specification and Claims

5. Details of the Amendment

(1) Specification page 3, lines 18 – 20 (English translation page 3, [0012], lines 25 – 28) "In order to attain said first object, the substrate having organic thin film of the present invention is characterized in that a buffer layer and organic thin film are

sequentially deposited on the substrate, and the buffer layer orients the organic thin film." is amended to

-- In order to attain said first object, the present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the substrate, characterized in that the buffer layer orients the organic thin film flatly.

The present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the substrate, characterized in that the buffer layer is acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly.

The present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the substrate, characterized in that the buffer layer is acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene. --

(2) Specification page 4, lines 8 – 10 (English translation page 4, [0015], lines 17 – 21) "In order to attain said second object, the transistor of the present invention is characterized in that it is a transistor having organic thin film formed on a substrate, and said organic thin film is deposited on the substrate via a buffer layer orienting the organic thin film." is amended to

-- In order to attain said second object, the transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on the substrate via a buffer layer accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly.

The transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the

organic thin film flatly.

The transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene. --

(3) Specification page 4, lines 23 – 25 (English translation page 5, [0017], lines 3 – 7) "In order to further attain said second object, the method of manufacturing a substrate having organic thin film of the present invention is characterized in that it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, and the buffer layer orients the organic thin film." is amended to

-- In order to further attain said third object, the method of manufacturing a substrate having organic thin film of the present invention is characterized in that it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, the buffer layer accelerates two dimensional growth of the organic thin film, and orients the organic thin film flatly. --

(4) Specification page 5, lines 6 – 8 (English translation page 5, [0018], lines 20 – 23) "Also, the method of manufacturing a transistor of the present invention is characterized in that organic thin film is formed on a substrate, and said organic thin film is laminated on a substrate via a buffer layer orienting said organic thin film." is amended to

-- Also, the method of manufacturing a transistor of the present invention is characterized in that organic thin film is formed on a substrate, and said organic thin film is laminated on a substrate via a buffer layer accelerating two dimensional growth of the organic thin film, and orienting said organic thin film flatly. --

(5) Claims page 19, Claim 1, lines 1 – 3 (English translation Claims page 21, Claim 1, lines 1 – 4) "A substrate having organic thin film, characterized in that:

a buffer layer and organic thin film are sequentially deposited on a substrate, and

said buffer layer orients said organic thin film." is amended to

-- A substrate having organic thin film, characterized in that:

a buffer layer and organic thin film are sequentially deposited on a substrate, and

said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly. --

(6) Claims page 19, Claim 6, lines 1 – 3 (English translation Claims page 21, Claim 6, lines 1 – 4) "A transistor provided with organic thin film formed on a substrate, characterized in that:

said organic thin film is deposited on said substrate via the buffer layer orienting said organic thin film." is amended to

-- A transistor provided with organic thin film formed on a substrate, characterized in that:

said organic thin film is deposited on said substrate via the buffer layer accelerating two dimensional growth of said organic thin film, and orienting said organic thin film flatly. --

(7) Claims page 20, Claim 11, lines 1 – 3 (English translation Claims page 22, Claim 11, lines 1 – 5) "A method of manufacturing a substrate having organic thin film, characterized in that:

it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, and

said buffer layer orients said organic thin film." is amended to

-- A method of manufacturing a substrate having organic thin film, characterized in that:

it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, and

said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly. --

(8) Claims page 20, Claim 16, lines 1 – 4 (English translation Claims page 23, Claim 16, lines 1 – 4) "A method of manufacturing a transistor provided with organic thin film formed on a substrate, characterized in that:

said organic thin film is deposited on said substrate via the buffer layer orienting said organic thin film." is amended to

-- A method of manufacturing a transistor provided with organic thin film formed on a substrate, characterized in that:

said organic thin film is deposited on said substrate via the buffer layer accelerating two dimensional growth of said organic thin film, and orienting said organic thin film flatly. --

(9) After Claims page 21, Claim 20 (English translation Claims page 24 to 25, Claim 20), the following Claims 21 – 24 are added.

-- 21. (added) A substrate having organic thin film, characterized in that: a buffer layer and organic thin film are sequentially deposited on the substrate, said buffer layer is acene system aromatics or its derivative, said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

22. (added) A substrate having organic thin film, characterized in that: a buffer layer and organic thin film are sequentially deposited on the substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene, said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

23. (added) A transistor, characterized in that: it is a transistor having organic thin film formed on a substrate, said organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of said organic thin film, and orienting the organic thin film flatly.

24. (added) A transistor, characterized in that it is a transistor having organic thin film formed on a substrate, said organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of said organic thin film, and orienting the organic thin film flatly, and said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene. --

6. List of Papers Attached:

(1) Specification, Substitute sheets, pages 3, 3/1, 4, 4/1, 5 (English translation, Substitute sheets, pages 3, 3/1, 4, 4/1, 5, 5/1)

(2) Claims, Substitute sheets, pages 19, 19/1, 20, 20/1, 21, 21/1 (English translation, Substitute sheets, pages 21 to 24)

tends to be columnar growth, and thin film of high quality has not so far been obtained.

[0009] Also, from conventional rubrene thin film, only amorphous film is obtained which shows almost no function of FET property or others. Further, since this amorphous thin film is quite reactive with oxygen, it becomes transparent when taken out to atmosphere from orange color in vacuum. Thus, thin film forming is difficult, and though quite high field effect mobility is reported for a single crystal, the thin film of high quality needed for practical use of FET has not been obtained.

Disclosure of the Invention

[0010] The present inventors have thought upon the present invention by discovering as the result of various trials that such organic materials as C_{60} and rubrene can be grown two dimensionally by inserting a buffer layer of such a material as pentacene between an organic material such as C_{60} and rubrene and a sapphire substrate.

[0011] In view of the problems mentioned above, it is a first object of the present invention to provide a substrate having organic thin film which can be grown two dimensionally such as C_{60} and rubrene.

The present invention has a second object to provide a transistor using a substrate having said organic thin film.

The present invention further has a third object to provide methods of manufacturing a substrate having said organic thin film and a transistor using the same.

[0012] In order to attain said first object, the present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the substrate, characterized in that the buffer layer orients the organic thin film flatly.

The present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the substrate, characterized in that the buffer layer is acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly.

The present invention is an organic thin film substrate in which a buffer layer and organic thin film are sequentially deposited on the

substrate, characterized in that the buffer layer is acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.

In the above-mentioned aspect, preferably a layer readily oriented with the buffer layer is inserted between the substrate and the buffer layer.

[0013] Said substrate is an insulating substrate, preferably a sapphire substrate, the buffer layer is acene system aromatics or its derivative, preferably pentacene or pentacene fluoride, and the organic thin film is either C_n fullerene (where n is an integer of 60 or

more), a C_n fullerene derivative, or rubrene. Preferably, the surface of the sapphire substrate is flattening-treated, and buffer layers made of pentacene or pentacene fluoride are laminated by a molecular layer unit.

[0014] According to the above-mentioned aspect, since extremely flat thin film of a unimolecular layer unit can be formed by inserting a buffer layer made of a specific material between the insulating substrates which so far had difficulty of crystal growth of such organic thin film as C_{60} and rubrene, organic thin film can be grown after growing these. Therefore, the strain between the substrate and the organic thin film such as C_{60} and rubrene is relaxed, the organic thin film such as C_{60} and rubrene can be grown two dimensionally, and its crystal particle diameter can be enlarged. Thereby, organic thin film of high crystalline quality can be obtained, and a substrate having organic thin film can be offered which has improved properties such as mobility of organic thin film.

[0015] In order to attain said second object, the transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on the substrate via a buffer layer accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly.

The transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly.

The transistor of the present invention is a transistor having organic thin film formed on a substrate, characterized in that the organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of the organic thin film, and orienting the organic thin film flatly, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.

In the above-mentioned aspect, preferably a layer readily oriented with the buffer layer is inserted between the substrate and the buffer layer. The substrate is preferably a sapphire substrate, the buffer layer is acene system aromatics or its derivative, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), a C_n fullerene derivative, or rubrene. Also preferably, the buffer layer is either pentacene or pentacene fluoride, and the organic thin film is either C_{60} or rubrene.

[0016] According to the above-mentioned aspect, the strain between the substrate and the organic thin film such as C_{60} and rubrene is relaxed by inserting a buffer layer made of a specific material, the organic thin film such as C_{60} and others can be grown two dimensionally, and its crystal particle diameter can be enlarged. Thereby, organic thin film of high crystalline quality can be obtained.

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As a consequence, a transistor such as a field effect transistor of high quality can be offered by improving mobility of organic thin film.

[0017] In order to further attain said third object, the method of manufacturing a substrate having organic thin film of the present invention is characterized in that it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, the buffer layer accelerates two dimensional growth of the organic thin film, and orients the organic thin film flatly.

In the above-mentioned aspect, a layer readily oriented with the buffer layer may be inserted between the substrate and the buffer layer.

The substrate is preferably an insulating substrate, especially a sapphire substrate, the buffer layer is acene system aromatics or its derivative, preferably pentacene or pentacene fluoride, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), a C_n fullerene derivative, or rubrene. Also preferably, the surface of the sapphire substrate is flattening-treated, and buffer layers made of pentacene or pentacene fluoride are laminated by a molecular layer unit. According to the present invention, organic thin film of high crystalline quality can be formed on a substrate.

[0018] Also, the method of manufacturing a transistor of the present invention is characterized in that organic thin film is formed on a substrate, and said organic thin film is laminated on a substrate via a buffer layer accelerating two dimensional growth of the organic thin film, and orienting said organic thin film flatly.

In the above-mentioned aspect, a layer readily oriented with the buffer layer may be inserted between the substrate and the buffer layer. Preferably, the substrate is an insulating substrate, preferably a sapphire substrate, the buffer layer is acene system aromatics or its derivative, preferably pentacene or pentacene fluoride, and the organic thin film is either C_n fullerene (where n is an integer of 60 or more), a C_n fullerene derivative, or rubrene. Preferably, the surface of the sapphire substrate is flattening-treated, and buffer layers made of pentacene or pentacene fluoride are laminated by a molecular layer unit.

[0019] According to the above-mentioned aspect, organic thin film of high crystalline quality is formed on a substrate, and thereby a

Claims:

What is claimed is:

1. (amended) A substrate having organic thin film, characterized in that: a buffer layer and organic thin film are sequentially deposited on a substrate, and said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

2. The substrate having organic thin film as set forth in claim 1, characterized in that a layer easily oriented with said buffer layer is further inserted between said substrate and said buffer layer.

3. The substrate having organic thin film as set forth in claim 1, characterized in that said substrate is an insulating substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.

4. The substrate having organic thin film as set forth in claim 3, characterized in that said insulating substrate is a sapphire substrate, said acene system aromatics is either pentacene or pentacene fluoride, and said C_n fullerene is C_{60}.

5. The substrate having organic thin film as set forth in claim 4, characterized in that the surface of said sapphire substrate is flattening-treated, and said buffer layer consisting of either pentacene or pentacene fluoride is deposited by molecular layer unit.

6. (amended) A transistor provided with organic thin film formed on a substrate, characterized in that: said organic thin film is deposited on said substrate via the buffer layer accelerating two dimensional growth of said organic thin film, and orienting said organic thin film flatly.

7. The transistor as set forth in claim 6, characterized in that a layer easily oriented with said buffer layer is further inserted between said substrate and said buffer layer.

8. The transistor as set forth in claim 6, characterized in that said substrate is an insulating substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.

9. The transistor as set forth in claim 8, characterized in that said insulating substrate is a sapphire substrate, said acene system aromatics is either pentacene or pentacene fluoride, and said C_n fullerene is C_{60}.

10. The transistor as set forth in claim 9, characterized in that the surface of said sapphire substrate is flattening-treated, and said buffer layer consisting of either pentacene or pentacene fluoride is deposited by molecular layer unit.

11. (amended) A method of manufacturing a substrate having organic thin film, characterized in that: it includes a process of sequentially depositing a buffer layer and organic thin film on a substrate, and said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

12. The method of manufacturing a substrate having organic thin film as set forth in claim 11, characterized in that a layer easily oriented with said buffer layer is further inserted between said substrate and said buffer layer.

13. The method of manufacturing a substrate having organic thin film as set forth in claim 11, characterized in that said substrate is an insulating substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n

is an integer of 60 or more), C_n fullerene derivative, or rubrene.

14. The method of manufacturing a substrate having organic thin film as set forth in claim 13, characterized in that said insulating substrate is a sapphire substrate, said acene system aromatics is either pentacene or pentacene fluoride, and said C_n fullerene is C_{60}.

15. The method of manufacturing a substrate having organic thin film as set forth in claim 14, characterized in that the surface of said sapphire substrate is flattening-treated, and said buffer layer consisting of either pentacene or pentacene fluoride is deposited by molecular layer unit.

16. (amended) A method of manufacturing a transistor provided with organic thin film formed on a substrate, characterized in that: said organic thin film is deposited on said substrate via the buffer layer accelerating two dimensional growth of said organic thin film, and orienting said organic thin film flatly.

17. The method of manufacturing a transistor as set forth in claim 16, characterized in that a layer easily oriented with said buffer layer is further inserted between said substrate and said buffer layer.

18. The method of manufacturing a transistor as set forth in claim 16, characterized in that said substrate is an insulating substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.

19. The method of manufacturing a transistor as set forth in claim 18, characterized in that said insulating substrate is a sapphire substrate, said acene system aromatics is either pentacene or pentacene fluoride, and said C_n fullerene is C_{60}.

20. The method of manufacturing a transistor as set forth in claim 19, characterized in that the surface of said sapphire substrate is flattening-treated, and said buffer layer consisting of either pentacene or pentacene fluoride is deposited by molecular layer unit.

21. (Added) A substrate having organic thin film, characterized in that: a buffer layer and organic thin film are sequentially deposited on the substrate, said buffer layer is acene system aromatics or its derivative, said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

22. (Added) A substrate having organic thin film, characterized in that: a buffer layer and organic thin film are sequentially deposited on the substrate, said buffer layer is acene system aromatics or its derivative, said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene, said buffer layer accelerates two dimensional growth of said organic thin film, and orients said organic thin film flatly.

23. (Added) A transistor, characterized in that: it is a transistor having organic thin film formed on a substrate, said organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of said organic thin film, and orienting the organic thin film flatly.

24. (Added) A transistor, characterized in that: it is a transistor having organic thin film formed on a substrate, said organic thin film is deposited on said substrate via a buffer layer consisting of acene system aromatics or its derivative, accelerating two dimensional growth of said organic thin film, and orienting the organic thin film flatly, and said organic thin film is either C_n fullerene (where n is an integer of 60 or more), C_n fullerene derivative, or rubrene.